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ABSTRACT

The construction of Gumpgookies, a test for measuring motivation of young children to achieve in school, is discussed. The test is rooted in a theoretical framework, which conceives of five constituents of motivation to achieve: (1) affective; (2) conceptual; (3) purposive; (4) cognitive; and (5) evaluative. Factor analysis and a type of cluster analysis were applied in order to judge the adequacy of the theory with reference to the original test format. Based on these and other techniques, the format was revised and administered to 1607 preschool children in 10 ethnic-cultural samples in the United States. Appropriate group forms were administered to 668 children in the first, second and fourth grades in Hawaii. Following extensive data analysis, factors were identified for both sample populations, some of which needed further study. Ultimately, the study is directed to deriving a better foundation for teaching motivation to children at various ages and of different backgrounds. It is suggested that further research might well be based on improved techniques for clarifying substantive motivational factors. Two such techniques are discussed. Exploratory efforts to teach motivation to preschool children are described. (TL)

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Factors of Motivation in Young Children: Theoretical and Empirical*

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Inter-related studies of the motivation of young children to achieve in school have been devoted to (a) development of a theory of motivation; (b) construction of a test to measure such motivation; and, more recently, (c) explorations of ways to teach motivation. This paper is devoted primarily to the first two aspects of the program.

After tryout of numerous techniques, a measuring instrument called Gumpgookies was constructed. Each item consists of two imaginary, rather amorphous figures called gumpgookies, which the examiner describes.

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The child chooses the one with which he identifies. For example, the examiner says:

"These gumpgookies are drawing circles.

This one is drawing a lot.

This one is getting them right.

Which is yours?"

Three forms of the test resulted from preliminary analyses: (a) a 75-item individual form for preschool children; (b) one 100-item group form for non-reading elementary school children; and (c) a second 100-item group form for elementary school children who can read.

The test was rooted in a theoretical framework, which conceives of five constituents of motivation to achieve: (a) affective, expressed as positive affect from achievement; (b) conceptual, whereby the individual sees himself as an achiever; (c) purposive, enabling the individual to establish and respond to future goals; (d) cognitive, by means of which the instrumental steps necessary to attain goals are known; and (e) evaluative, through which the individual can evaluate his own performance.

With the first format of the test, factor analysis and a type of cluster analysis were applied in order to judge the adequacy of the theory. The factors, however, were partially determined by one or both of two extraneous influences: the position of the correct alternative--right or left--and the order in which the alternatives were presented. With the original format, the effects of these two influences could not be separated, because the alternatives were read by the examiner from left to right. An additional extraneous influence affecting some factors

seemed to be the position of an item in the test--toward the beginning or toward the end. However, this could be attributable to the fact that items more concrete in nature had been placed at the beginning, with more abstract content appearing later.

Various methods were used to shed light on these influences, which are of compelling interest in their own right. Artificial score matrices with predictable factor structure were constructed. For various proportions of subjects, these were overlaid with answer-position preferences. When the structure was strong, such preferences for about a fourth of the subjects produced answer-position factors. For weaker structures, position preferences for only a fifth or a sixth of the subjects were sufficient.

Another technique was to separate the items in an early form of the test into those with answers to the right and those with answers to the left. Items within each group preponderantly correlated positively with those in the same group and negatively with those in the other group. The positive correlations averaged higher than the negative, however, confirming that the test measured something in addition to extraneous factors.

An effort was also made to segregate subjects who exhibited significantly more or fewer runs in their answers than were characteristic of the key and then to factor the correlation matrix based upon the remaining subjects. This venture was not completely successful, however, perhaps because of inadequate criteria for separating the subjects.

The format was revised so that the illustrations appeared in various positions, and the order in which the figures are described was

randomized. Many items for the individual form were revised to reduce the cognitive difficulty.

This form was administered to 1607 preschool children in 10 ethnic-cultural samples scattered over the United States. The appropriate group forms were administered to 668 children in the first, second, and fourth grades in Hawaii.

Separate solutions for six factors were obtained for each of the ethnic-cultural groups, each of the grade groups, the ethnic-cultural groups combined, grades 1 and 2 combined, and grades 1, 2, and 4 combined. The correlation coefficients among the loadings of the 60 factors for the 10 groups of preschool children were themselves factored, as were those for the 18 factors for grades 1, 2, and 4. By reference to the original factor solutions, items were assigned in each case to one of six super-factors. This technique involved some subjectivity in assignment of items, and later efforts were addressed to improved super-factors that resulted from factorizations of data for the combined groups.

The two latter solutions, which were not expected to be identical, could be compared to some degree because the items used for younger children had been selected from those used for older. Many items, however, had been revised in wording, and the answer positions and order of presentation of alternatives were not necessarily identical.

For some super-factors, as well as for some factors for the several subgroups, the three types of extraneous influences mentioned above, which seem to be "characteristics of the organism," again were apparent. The effects of answer position seem to be somewhat more prominent for the younger children, while primacy or recency sets have appeared to be more in evidence for the older children.

Despite these troublesome non-substantive influences on factors, scores on the total test, considered for a group of subjects, should not be systematically affected unless all subjects have the same answer-position, item-position, and primacy versus recency tendencies. Inspection of answer sheets reveals no such similarities. However, when individual children find test items difficult, their total scores may be distorted by idiosyncratic proclivities to be affected by irrelevant tendencies.

Although a very large number of factor analyses have been completed by now, clearly they cannot all be reported within the confines of a brief paper. Let us consider briefly, however, results for two sets of improved super-factors based on total groups.

The rationale for combining subsamples warrants mention. Although children of the several ethnic-cultural groups and those of different ages surely differ in motivational factors, some bases by which to compare groups are needed. Hence the approach of this series of analyses has emphasized identification of factors by means of which subgroups eventually could be compared. When the question of similarity of factorial solutions based upon subsamples of different ages or ethnic-cultural composition was first given attention, techniques for rotating to maximally similar structures were considered. Since one purpose was to examine inter-group differences as well as likenesses, however, solutions that would maximize similarities were rejected.

For the combined samples of first-, second-, and fourth-graders, the five most clearly identified super-factors were self-confidence,

a conceptual response; work enjoyment, an affective response; instrumental activity, a cognitive response, i.e., knowing what action to take; responsiveness to future goals, a purposive response; and self-evaluation, an evaluative response. These interpretations dovetail nicely with the postulated components of motivation, although the last two are not so clear as the first three, suggesting that more items are needed to measure them. The sixth factor, represented by six items, with only two loadings of .30 or above items, may represent dependability or self-reliance, a constituent not provided for in the theory. In later analyses, fourth-graders have been omitted, because it has become clear that some items in the test are not well suited to their age level.

For the total group of 1,607 preschool children, the following factors were very tentatively identified: general constructive activity, self-evaluation, optimistic self-confidence, persistence, and work enjoyment. Further study of such factors is needed, both with respect to differences in the extent to which they are revealed for different subgroups and with respect to their relation to factors for the older groups of subjects. Moreover, research will be needed on the etiology of motivation before the relation of the factors for younger groups to those for the older groups can be fully understood. If, for both different age and ethnic-cultural groups, a rationale for the differences can be formulated and tested against empirical results, a better foundation for teaching motivation to children at various ages and of different backgrounds can be provided. This further research can well be based on improved techniques, as will be explained shortly.

Methodological solutions are at hand that are helping to clarify substantive motivational factors, free of the unwanted consequences of the vexatious set factors that hamper interpretations.

One very promising approach involves first obtaining three response set scores for each subject: the number of answers he selected that are in the left-hand position; the number of answers he selected that are in the up position; and the number of answers he selected that the examiner had read first--a primacy versus recency score. These three variables are then partialled out of the item intercorrelation matrix and the residual matrix is factored. Paul Horst has been of great assistance in the development of a computer program yielding exact factor scores that are exactly orthogonal to the three response-set scores. The program also includes a routine for obtaining integral weights of -1, 0, or 1 for each item for each factor and for obtaining approximate factor scores that correlate very highly (from .91 to .96 in one solution) with the exact factor scores. In this solution, the KR-20 reliability estimates for the five factors were .54, .63, .65, .66, and .66. In this solution, which was based on 435 first- and second-graders, the clearest factors are work enjoyment and self-confidence. A third is interpreted as instrumental activity and a fourth as involving self-evaluation. This last interpretation is still tentative, partly because the items on the factor are concentrated in the last half of the test, a finding suggestive of persistence. The fifth factor may be purposive, but in this solution it involves too few items to make the interpretation compelling.

We are just now completing two applications of this new technique to data on the 75-item form of the test that has been given to some 2500 children. They represent several ethnic-cultural groups and range in age from three and a half to seven and a half. Subjects have been assigned at random to one of two groups and separate analyses carried out to yield eight factors for each group. The number of factors has been increased from five to eight because it is thought that the factors differ for children of different ages. This approach should provide a crucial test of the factor stability.

Another method that is being considered will necessitate giving different forms of the tests to different groups of subjects. All forms will contain identical content, but answer positions (i.e., left, right, up, down) and order of presentation of alternatives will be varied systematically. Factoring pooled data for the eight different forms that would be required should yield factors independent of extraneous set influences. Theoretically, it also would be possible to vary systematically the positions of the items in the test, but this could add appreciably to printing costs. However, to interchange halves of the test would be feasible.

Aside from the extensive studies made to explore the factorial validity of the test, item difficulty indices and item-test correlation coefficients have been computed routinely. KR-20 reliability estimates have ranged from the low .80's to the low .90's. Test-retest reliability estimates obtained for first- and second-graders have been in the neighborhood of .65. Gumpgookies correlates in the neighborhood of .20 to .35 with IQ for fairly homogeneous age groups. For a sample

of four-year-olds, its correlation with the Preschool Inventory, a test designed by Bettye Caldwell to measure achievement in preschool children, was .31. The relation with age is low and positive for groups with age ranges of slightly over 12 months.

To date, efforts to develop external criteria have been limited to teacher rankings based upon various procedures. Although some teachers produce more reliable ratings than others, almost all correlations with teacher rankings have been positive, with about half significantly different from zero. The test discriminated significantly ($p \leq .05$) between the upper 15% and the lower 15% for three groups of children--four-year-olds and those in grades 1 and 2--as determined by teacher rankings. For grade 4, the difference was not significant.

Concurrent with the later stages of development of a measuring instrument have been exploratory attempts to teach motivation to preschool children. A curriculum, consisting of separate units on each component of motivation specified in the theory, was presented to teachers of three Head Start classes in 1968-69. Although regular meetings were held with the teachers and the classes were regularly observed, closer monitoring of the procedures was seen to be essential if there is to be assurance that such a curriculum is actually applied as intended. Nevertheless, the project was regarded as sufficiently promising to justify further efforts to teach motivation with a revised curriculum, and teachers in eight Head Start classes participated with us in further experimental work in the 1969-70 school year. The results will be analyzed and reported in the near future.

A full report of our work through the fall of 1969 should be available through ERIC and is being prepared for publication as a monograph. The new method of factoring to yield substantive scores uncorrelated with response set scores will be the subject of a separate article.